

POLLUTION CONTROL STUDY  
FOR  
NATIONAL POLYCHEMICALS INC.  
AT  
Wilmington, Massachusetts

Job No. E-3341  
August 21, 1969

The Badger Company, Inc.  
Cambridge, Massachusetts

## INTRODUCTION

This report presents a summary of aqueous waste disposal practices and pollution control recommendations for National Polychemicals Incorporated, Wilmington, Massachusetts. Contained herein is a description of the sewer systems as well as all processes from which aqueous wastes emanate. Recommendations are offered which will expedite the design of waste pre-treatment facilities as required by the Sewerage Division of the Metropolitan District Commission.



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## SECTION I

### SUMMARY AND RECOMMENDATIONS

#### 1.1 SUMMARY

As of August 15, 1969, National Polychemicals Inc. completed a major waste abatement and segregation program. As a result of the installation of closed cooling water systems, the volume of aqueous wastes have been reduced by approximately 90%. All process wastes which previously flowed into the Aberjona River have been segregated into two separate sewer systems which discharge into an enclosed acid pit southeast of the plant. The contents of the acid pit seep into the ground water table. Yard drains and floor drains from the plant flow ultimately into the Aberjona River. Sanitary wastes are treated in septic tank-field tile systems.

National Polychemicals Inc.'s waste segregation project was designed to abate pollution of the Aberjona River and to prepare for pretreatment of all process wastes prior to discharge into a new Metropolitan District Commission sewer. Construction of the proposed Metropolitan District Commission sewer which will be located adjacent National Polychemicals Inc.'s property is scheduled for completion during mid-1970.

#### 1.2 RECOMMENDATIONS

##### 1.21 Segregation

Floor drains in processing areas should be rerouted into the process sewer system to eliminate the possibility of a spill reaching the Aberjona River.

All storage tanks which receive bulk truck shipment of liquid chemicals should be curbed to prevent contamination of yard drainage from spills which occur during unloading. Curbed areas should be drained to the process sewer system. (Ref. Fig. I)

##### 1.22 Preparation for Pretreatment

At the present time it appears that at least flow equilization and neutralization of process wastes will be required as a prerequisite for discharge into the Metropolitan District Commission sewer system. Additionally, it appears that a rationally designed oil interceptor should be installed on the yard drainage sewer system to prevent floating material from reaching the Aberjona River.

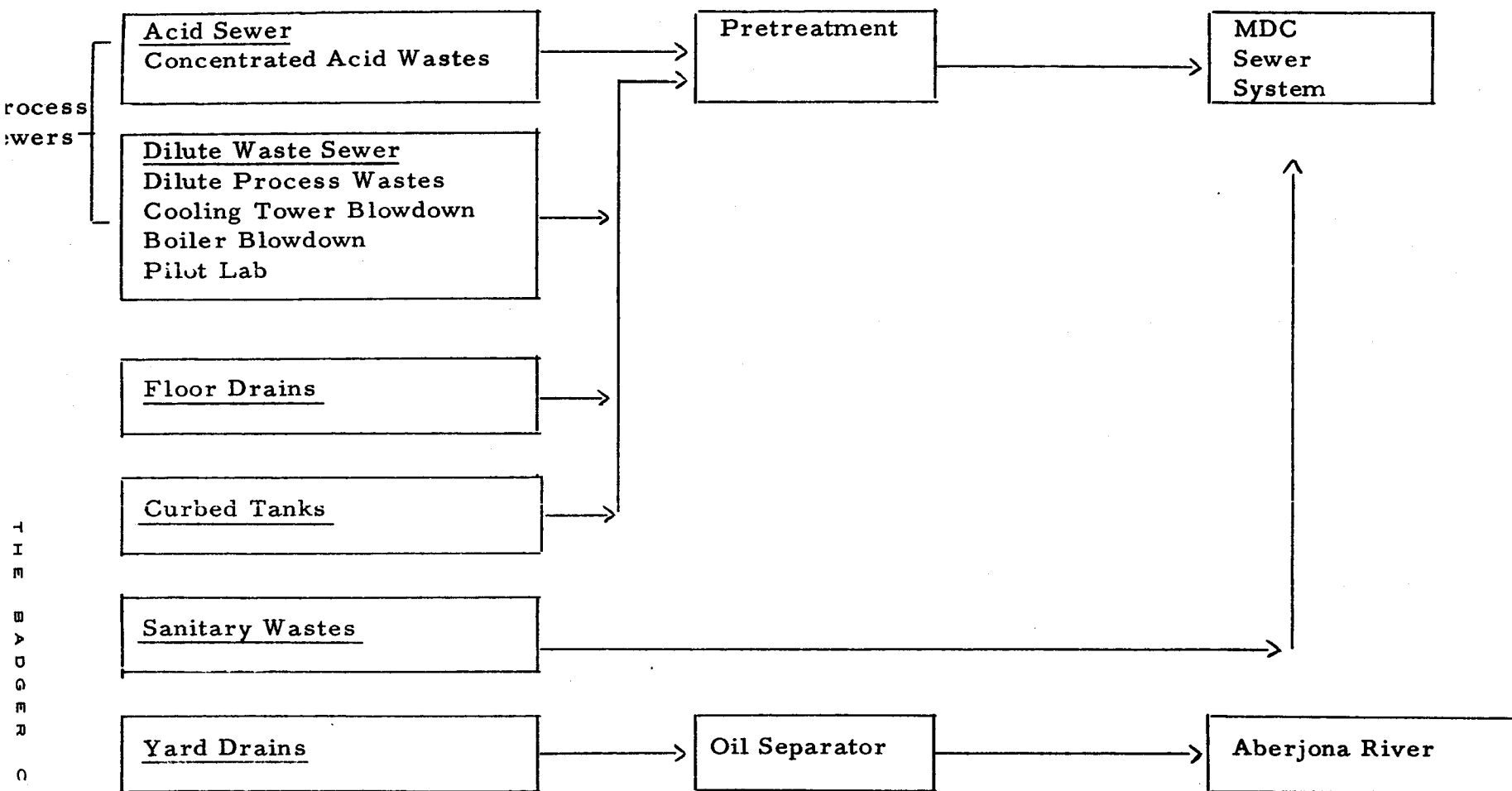


FIGURE I  
NATIONAL POLYCHEMICALS INC.  
Recommended Sewer Systems



## 1.22 Preparation for Pretreatment (cont'd)

To expedite the design of adequate pretreatment facilities a waste survey should be initiated as soon as possible. The following tests should be completed on the effluent from the process sewers and the yard drain sewer.

- Flow rate
- pH
- Alkalinity
- Acidity
- Suspended Solids (before and after neutralization with sodium hydroxide and calcium hydroxide)
- Oil and Grease
- COD
- BOD

Since the wastes emanate from batch or semi-batch operations the analyses should be performed on composite, flow proportioned samples. Laboratory analyses should conform to methodology presented in Standard Methods for the Examination of Water and Waste Water, 12th Ed. A. P. H. A., Inc. (Ref. Appendix)



## SECTION II

### DISCUSSION

#### 2.1 SEWER SYSTEM

National Polychemicals Inc. has undertaken a project to segregate plant sewer systems. The new sewer systems were completed August 15, 1969. There are now three distinct sewer systems consisting of a sanitary sewer system, process sewer system and a yard and floor drainage sewer system. (Ref. Fig. II)

Sanitary sewage from various locations flows via the sanitary sewer to septic tanks for gross solids removal. The effluent from the septic tanks is allowed to leach into the ground by means of conventional tile field systems.

A new 4" - 6" acid sewer system of Bondstrand series 5000 epoxy has been installed to handle concentrated acid wastes from plants C-1, C-3 and Bldg. 17. The strong acid wastes from the new acid sewer are discharged into the acid pit southeast of the plant. Construction of the new acid system was completed August 15, 1969. (Ref. Dwg. E-3191-240A)

A dilute waste system of cast iron and vitrified clay has been installed and is used to collect all process wastes other than strong acids. This dilute waste system also empties into the acid pit southeast of the plant.

All yard drainage and process area floor drainage is collected in trench drains and is discharged to a sewer which has been installed in the area where Lake Poly used to be. The yard and floor drainage system was completed August 15, 1969. The yard drainage system discharges into the creek which subsequently flows into the Aberjona River. (Ref. Dwg. E-3191-240A)

Three acid pits with a total surface area of about one half an acre are situated on an east-west line 400 ft. south of the National Polychemicals Inc. railroad spur. The center, and largest, pit has been used to contain acid wastes from the Kempore process. The liquid level in the pits appears to be about 10 ft. below grade. The east and west pits exhibit emergent vegetation and algal growths. Due to the acid environment there is apparently no life in the center pit. Since the average rainfall in New England exceeds evapo-transpiration by approximately 20 inches per year and there are no outlets, the contents of the acid pits probably leach into the ground water table. (Ref. Dwg. E-3191-240A)

#### 2.2 SOURCES OF WASTES

##### 2.21 Sanitary Wastes

The sanitary sewer system services 5 urinals, 7 water closets, 6 laboratories, 3 showers and 4 drinking fountains. Approximately 35



Process  
Sewers

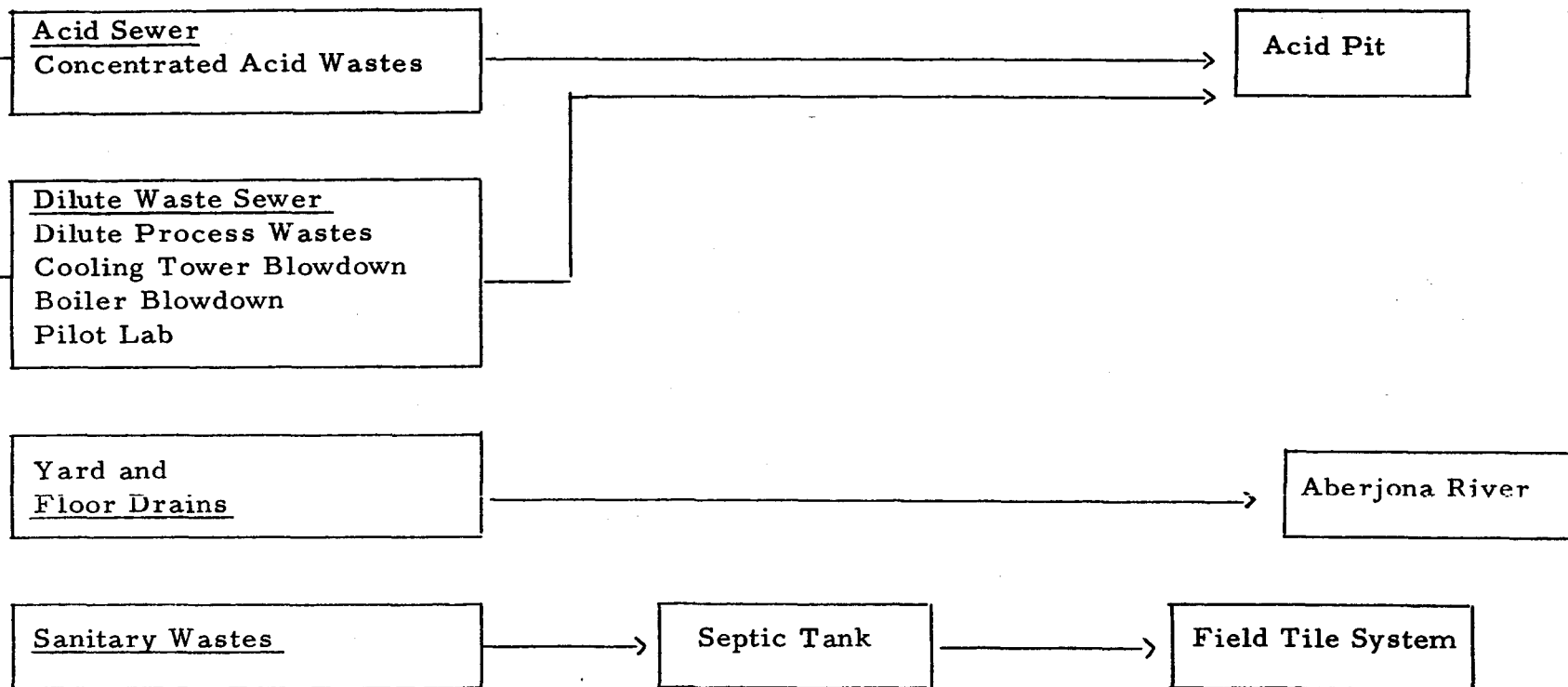


FIGURE II  
NATIONAL POLYCHEMICALS INC.  
SEWER SYSTEMS  
as of August 15, 1969



## 2.21 Sanitary Wastes (cont'd)

office personnel and 53 production personnel use these fixtures on a daily basis. The sanitary systems flow into two septic tanks and subsequently into leaching fields.

## 2.22 Process Wastes

At present National Polychemicals Inc. is operating four processes and a coating manufacturing facility. By December 1, 1969 a fifth process facility will be in operation. The following is a synopsis of the processes with particular attention given to the wastes emanating from each process.

## 2.23 Process Descriptions

Opex Process (Ref. Dwg. E-3341-101A) / Dinitropentamethylenetetramine (DNPT) is a light yellow, slightly water soluble solid used as a blowing agent in the production of expanded rubber compounds. National Polychemicals Inc. produces  $1.2 \times 10^6$  lb/yr of DNPT in 4-5 batches per 24 hours, six days per week.

Anhydrous ammonia and formaldehyde are reacted in an agitated batch type reactor fitted with an external pump through cooler to form 30% solution hexamethylenetetramine (HEXA). Upon completion of the reaction in plant B the HEXA solution is pumped to a storage tank located in plant A. HEXA and sodium nitrite are mixed in a cooled, covered compound tank. The contents of the compound tank are pumped to one of two agitated DNPT reactors which is charged with dilute hydrochloric acid and ice. As the temperature of the reactor drops DNPT precipitates out of solution. Upon completion of the reaction the contents are pumped to one of two pan filters. The product DNPT which is retained on the filter is washed with water and manually transferred into drying pans, dried and packaged.

The filtrate from the pan filter which has a pH of approximately 4 and contains sodium chloride, sodium nitrite, formaldehyde, and traces of hydrochloric acid, hexamethylenetetramine, DNPT and process oil is discharged into a retention tank where the remaining DNPT is floated off. The aqueous underflow from the retention tank is discharged to the dilute process sewer and subsequently flows into the southeast acid pit.

From material balance calculations approximately 103,000 lb/mo sodium chloride, 18,500 lb/mo formaldehyde and 10,000 lb/mo sodium nitrite are sewered from the Opex Process.



## 2.23 Process Descriptions (cont'd)

Kempore Process (Ref. Dwg. E-3341-101B) National Polychemicals Inc. produces  $1.6 - 1.8 \times 10^6$  lb/yr of Kempore (Azodicarbonamide) which is a slightly water soluble, orange-yellow solid used as a rubber blowing agent. Production of Kempore is a semi-batch operation executed on a 24 hour basis 5-6 days per week.

Liquid chlorine and urea are reacted in a batch reactor located in plant C-3 to produce monochlorourea (MCU). MCU is stored in a day tank prior to a reaction with 30% sodium hydroxide in a titanium pipe reactor. The effluent from the titanium reactor is discharged into an agitated, cooled reactor where 66° Be' sulfuric acid is added producing large quantities of CO<sub>2</sub> which are vented to the atmosphere. The contents of the reactor are pumped to an open pan filter where a 3.0% hydrazine solution is recovered in the filtrate stream. After manual washing of the filter cake consisting of sodium sulfate and sodium chloride, the cake is dumped into an agitated salt solution tank. The salts are dissolved into hot water in the salt solution tank and discharged to the dilute process sewer which flows to the southeast acid pit.

From material balance calculations approximately 300,000 lb/mo sodium sulfate and 305,000 lb/mo sodium chloride are sewered from the hydrazine production section of the Kempore Process.

The 3.0% hydrazine filtrate solution is stored in day tanks outside plant C-3 and C-1. Hydrazine solution is pumped to plant C-1 into one of three reactors where sulfuric acid is added to form hydrazodicarbonamide (HDCA) in slurry form. HDCA is filtered on a rotary drum vacuum filter to increase the HDCA concentration. The filtrate containing sodium chloride, sodium sulfate, urea and ammonium sulfate is filtered and discharged to the dilute process sewer.

The 20% slurry of HDCA is pumped into a water cooled, agitated reactor, where sulfuric acid and sodium chlorate are added forming a heavy slurry of azodicarbonamide. The azodicarbonamide slurry is vacuum filtered, dried and packaged. Filtrate from vacuum filter containing sodium sulfate, urea, azodicarbonamide and 4-8% sulfuric acid is filtered and discharged to the process acid sewer.

From material balance calculations approximately 40,000 lb/mo sodium sulfate, 164,000 lb/mo ammonium sulfate, 101,000 lb/mo urea, and 24,000 lb/mo sulfuric acid are contained in the combined filtrate streams.



## 2.23 Process Descriptions (cont'd)

Wytox Process (Ref. Dwg. E-3341-101C) Wytox, a liquid phosphite rubber stabilizer is produced 2-4 days per week on a batch basis amounting to one million lb/yr.

Phosphorous trichloride, paraformaldehyde and nonylphenol are reacted in an agitated vessel located in plant C-1. During the reaction 16,000 lb/mo hydrogen chloride gas evolves which is scrubbed and sewerred to the acid sewer. Upon completion of the reaction the entire contents of the reactor are pumped into drums for shipping. With the exception of the scrubber liquor, there are no waste process streams which are sewerred.

Wytox ADP-X Process (Ref. Dwg. E-3341-101D) Wytox ADP-X /Diocetyldiphenylamine (DODPA)/ a dark colored resinous solid is produced 3 to 5 days per week on a batch basis in plant B. National Polychemicals Inc.'s total production of DODPA is approximately 600,000 lb/yr.

Diphenylamine (DPA) and diisobutylene (DIB) undergo a Friedel-Crafts reaction through the use of an aluminum chloride catalyst. DPA and DIB are reacted with the catalyst in an agitated reactor. The reactor is fitted with a condenser and condensate drum to reflux the DIB. When the reaction has been completed, the aqueous and organic layers are allowed to separate. The aqueous layer containing sodium chloride, aluminum hydroxide, DODPA and DIB is sewerred to the dilute process sewer. The organic layer is washed twice with water. Both washes are also discharged to the dilute process sewer. Following the two washings the reactor is placed under a vacuum by means of a steam jet. While under vacuum the DIB is distilled into the condensate drum leaving DODPA in the reactor. The tar-like DODPA product is discharged from the reactor and is allowed to solidify prior to grinding and packaging.

From material balance calculations approximately 19,000 lb/mo diisobutylene, 1,250 lb/mo aluminum hydroxide and 2,400 lb/mo sodium chloride are discharged to the process sewer from the Wytox ADP-X Process.

O.B.S.H. Process (Ref. Dwg. E-3341-101-E) As of December 1, 1969, National Polychemicals Inc. expects to be producing 300,000 lb/yr of oxybissulfonylhydiazine (OBSH) in plant 17. OBSH, a rubber blowing agent, will be produced 5 days per week on a 24 hour basis.

~~Oxybissulfonylhydiazine~~  
Diphenyl oxide and chlorosulfonic acid will undergo a quench reaction producing hydrogen chloride gas, oxybissulfonyl~~oxide~~ (OBSC), a white water insoluble solid, and a 15-20% sulfuric acid solution. The hydrogen chloride gas is to be scrubbed and recovered for reuse. The 15-20% sulfuric acid solution will be discharged into the new acid sewer which flows to the acid pit southeast of the plant. Process waste data is being developed in a pilot plant facility.

## 2.23 Process Descriptions (cont'd)

O. B. S. H. Process (cont'd) - The OBSC is to be reacted with a hydrazine solution to form OBSH. The solid OBSH is to be filtered, dried and packaged. Filtrate from the product will be pumped to the Kempore Process for reuse.

Coatings National Polychemicals Inc. produces numerous coatings for rubber products. These coatings are compounded on a batch basis from the following chemicals:

- Bentone
- Santocel
- Ufamite MM 67
- Toluene
- Butylacetate
- Acrylic Resins
- Maleic Anhydride
- Glycerine
- Fatty Amines
- Silicone
- Monoethanolamine
- Mineral Oil

The production of the coatings is a non-aqueous operation without waste.

## 2.24 Cooling Water System

Field data has revealed that normal cooling water demands are 375 gpm with a peak demand of 555 gpm. Until recently, city water was used for cooling on a once through basis and sewered ultimately to the Aberjona River. Installation of a multi-tower closed cooling water system with a design capacity of 700 gpm was completed August 15, 1969.

The cooling towers associated with plants A, B and C-1 are to operate at a high number of cycles of concentration. Minimal blowdown to the process sewer will occur on a periodic basis. Cooling water from the plant C-3 cooling tower is to be used in the hydrazine scrubber (Kempore Process) which discharges to the process sewer and will therefore provide a 20 gpm purge for the plant C-3 cooling system.

Chemical treatment of the cooling water will be accomplished on a contract basis with a chemical supplier. The corrosion inhibition chemicals have not been selected; however, it appears than an inorganic-organic zinc inhibitor or an entirely organic inhibitor system will be used.



## 2.25     Boiler Systems

National Polychemicals Inc. is presently operating 15 psi boilers with a total capacity of 450 horsepower and 150 psi boilers with a total capacity of 135 horsepower. Softened city water is used for make up water. Proprietary chemicals containing amines are used for boiler scale control. Solids in the steam drum are controlled through periodic manual blowdown to the process sewer.

## 2.26     Yard and Floor Drainage

Yard drainage and floor washings from an area of undetermined size are sewered via the Lake Poly sewer. Contaminants from roadways, unloading areas and process areas are likely to appear in the effluent from the Lake Poly sewer system. Significant amounts of pollutants are likely to emanate from truck unloading stations such as the nonylphenol tank and process area floor drains as a result of spills.

The Lake Poly sewer now flows into an oil basin which is capable of removing gross amounts of light insoluble material. The underflow from the oil basin flows into a creek and subsequently the Aberjona River. (Ref. Dwgs. E-3191-240A and 232A)

## 2.3     METROPOLITAN DISTRICT COMMISSION SEWER SYSTEM

During the summer of 1970 a Metropolitan District Commission sewer is to be extended along National Polychemical Inc.'s property. (Ref. U.S.G.S. Map) The sewerage division of the Metropolitan District Commission will accept sanitary sewage as well as industrial wastes in the Metropolitan District Commission sewer system as long as the wastes conform to the following rules and regulations.

### RULES AND REGULATIONS

#### COVERING

#### DISCHARGE OF SEWAGE, DRAINAGE, SUBSTANCES OR WASTES

Pursuant to authority and in compliance with the directive of the Massachusetts Legislature as found in Massachusetts Acts of 1945, Chapter 705, Section 12, the Metropolitan District Commission, at its regular meetings on August 5 and 19, 1948, voted to establish the following rules and regulations covering the discharge of sewage, drainage, substances or wastes into any sewer under its control, or any sewer tributary thereto, with the North Metropolitan Sewerage District or the South Metropolitan Sewerage District.

Attention is invited to the fact that the above referred to legislation provides that failure on the part of any municipality to comply with the following rules and regulations shall be sufficient cause for the levying and collection of additional assessments.



MDC Rules and Regulations (cont'd)

1. No municipality shall discharge or cause or allow to be discharged into any sewer under the control of the Metropolitan District Commission, or any sewer tributary thereto within the North or South Metropolitan Sewerage Districts, any sewage, drainage, substances or wastes containing caustic alkalinity, calculated as  $\text{CaCO}_3$  (calcium carbonate), in excess of 75 parts per million by weight, in volumes which may be determined by the Metropolitan District Commission to be excessive.

2. No municipality shall discharge or cause or allow to be discharged into any sewer under the control of the Metropolitan District Commission, or any sewer tributary thereto within the North or South Metropolitan Sewerage Districts, any sewage, drainage, or substances or wastes containing unsaponified greasy or fatty matters in volumes which may be determined by the Metropolitan District Commission to be excessive.

3. No municipality shall discharge or cause or allow to be discharged into any sewer under the control of the Metropolitan District Commission, or any sewer tributary thereto within the North or South Metropolitan Sewerage Districts, any sewage, drainage, substances or wastes containing suspended solids in excess of five hundred parts per million by weight in volumes which may be determined by the Metropolitan District Commission to be excessive, or any matters in such volumes as, in the opinion of the Commission, may tend to obstruct or impede the flow in the sewers, or be injurious to the sewers, pumps or other portions of the sewerage systems or be likely to create a nuisance or a hazard within or without said sewers.

4. No municipality shall discharge or permit to be discharged into any sewer under the control of the Metropolitan District Commission, or any sewer tributary thereto, within the North or South Metropolitan Districts, free mineral acids in quantities which the Metropolitan District Commission determines to be excessive.

5. No municipality shall cause or allow to be discharged into any sewer under the control of the Metropolitan District Commission or any sewer tributary thereto within the North and South Metropolitan Sewerage Districts, any sewage, drainage, substances or wastes from an industrial or manufacturing plant unless measuring devices or other means of measuring the flow of the sewage, drainage, substances or wastes are provided at the request of and in accordance with the approval of the Metropolitan District Commission, and the records of flow from such measuring devices shall be furnished the Metropolitan District Commission upon request therefor.

6. All applications to discharge any sewage, drainage, substances or wastes directly into any sewer under the control of the Metropolitan District Commission shall be accompanied by an agreement signed jointly by the owner



## MDC Rules and Regulations (cont'd)

of the industry contributing such sewage, drainage, substances or wastes and a representative of the municipality in which the connection is located who is authorized to sign agreements on behalf of the said municipality stating that the manufacturer or industry in question agrees to abide by all rules and regulations of the municipality and the Metropolitan District Commission and that the owner of the industry will provide suitable devices or other means of measuring the flow of the sewage, drainage, substances or wastes and will provide such works for the preliminary treatment of the sewage, drainage, substances or wastes as may be required by the Metropolitan District Commission.

7. No municipality shall discharge or cause or allow to be discharged into any sewer under the control of the Metropolitan District Commission or any sewer tributary thereto within the North or South Metropolitan Sewerage Districts, any sewage, drainage, substances or wastes which are of an explosive or inflammable nature.

8. Municipalities will be held responsible for the enforcement of Section 2 of the rules and regulations of the Massachusetts Department of Public Safety necessitating that garages and other establishments where gasoline is used and which are connected with the public sewers in the North or South Metropolitan Sewerage Districts be supplied with a suitable trap or separator. Such traps and separators shall be subject to the approval of the Metropolitan District Commission.

9. No municipality shall contract for the building of additional sewerage works contemplated for connection into the Metropolitan Sewerage System until plans and specifications covering such works are submitted to and approved by the Chief Sewerage Engineer of the Metropolitan District Commission, and notice is hereby given that the Metropolitan District Commission will not approve, except under extraordinary conditions, any works designed on the so-called combined system or the discharge of processing or condensing water which the Department of Public Health determines is sufficiently free from contamination to permit its discharge into the nearest water course.

10. No municipality shall discharge or permit to be discharged into the Metropolitan Sewerage System, or tributaries thereto, sewage, drainage, substances or wastes containing amounts of ground, tide, or river water determined by the Metropolitan District Commission to be excessive.

\* Now Section 28 of Form F. P. R. - 14 of the Rules and Regulations of the Board of Fire Prevention of the Department of Public Safety.

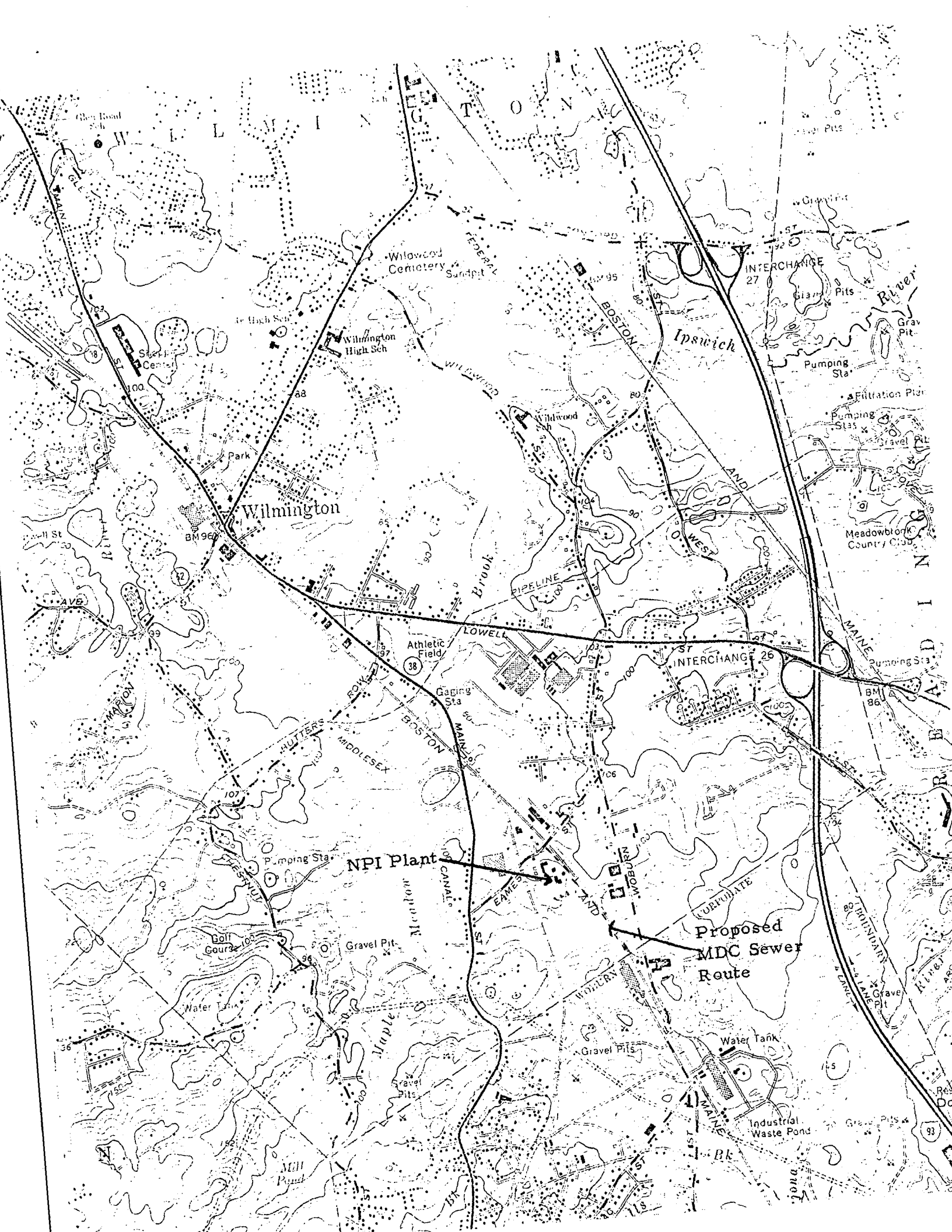


SECTION III

APPENDIX

3.1 U. S. G. S. Map





### 3.2 DRAWINGS

E-3191-231A	Process Sewer System Plant A
E-3191-232A	Process Sewer System Plan and Details Plant B
E-3191-234A	Process Sewer System Plan and Details Plants C-2 and C-3
E-3191-235A	Process Sewer System Plant C-1
E-3191-240A	Process Sewer System Main Plot Plan



Dwg. No. 3191-231A